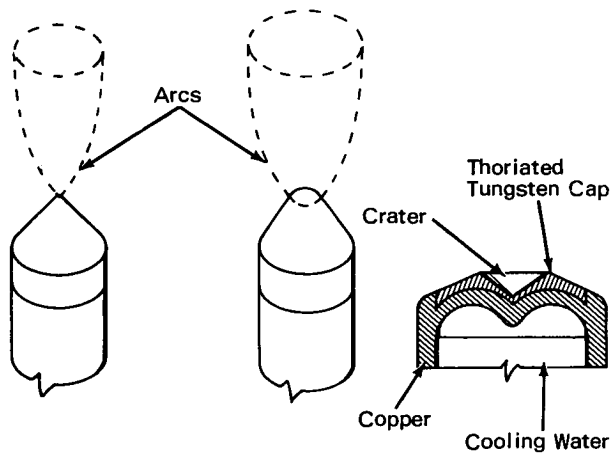
August 1971 Brief 71-10264

NASA TECH BRIEF

Lewis Research Center

Durable Cathodes for High-Power Inert-Gas Arcs

A nonconsumable cathode can be used in a high-power, free-burning, inert-gas arc, such as those used as radiative sources in solar simulators. The cathode operated for 40 hr in an arc consuming more than



Conventional (left) and Annular Cathodes

200 kW, where previous arcs used as light sources were limited to an input of 20 kW. The design minimizes evaporation of the electrode material, which may deposit on associated optical surfaces. It also results in stable operation and precise positioning of the arc relative to the optical collector. This innovation may be applicable to high power light sources and to arcs used in industrial furnaces.

The water-cooled, hollow copper cathode has a thoriated-tungsten cap (see fig.). A unique design feature results in the distribution of the total heat that must be conducted through the cathode's tip to the cooling water, thus preventing local overheating. A conical crater is machined in the cathode cap so that, during operation, the arc spreads over the entire crater and forms a molten annulus near the rim. The area of the arc's attachment to the cathode, called the annular cathode, is much larger than the point attachments on conventional cathode tips, so that the total heat load is distributed.

The cathode's internal coolant passage is also designed to increase the area for heat transfer to the cooling water. The internal surface is curved, with a central fin. Thermal resistance between the cathode's tip and the cooling water is minimized as a result of two other design features: The tungsten cap is vacuum cast on the copper enclosing the water passage, so that a good thermal bond is ensured; and the water passage is gold plated to resist decreases in the thermal conductivity by depositions from the cooling water.

In comparison with a conventional device, the annular cathode reduces the total absorption of heat into the anode because the arc on this device has a larger area of attachment to the anode. An annular cathode has been run for 40 hours between 200 and 400 kW in argon. The separation between electrodes was about 7.62 cm; the ambient pressure, between 201 and 805 kN/m^2; and the current, between 2600 and 4000 A.

Note:

No further documentation is available. Specific questions, however, may be directed to:

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Reference: B71-10264

(continued overleaf)

Patent status:

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